OFFICE OF THE

POLICE COMPLAINT COMMISSIONER

TASER TECHNOLOGY REVIEW
FINAL REPORT

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MEDICAL REVIEW

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PATHFINDER FORUM
CONSULTING IN FORENSIC MEDICINE & PATHOLOGY

British Columbia: Office of the Police Complaint Commissioner
C/O Victoria Police Department.
850 Caledonia Ave.,
VICTORIA, BC. V8T 5J8
Attention: Inspector Wm. Naughton

May 17, 2005

Dear Sirs:

Review of reports: Taser Technology Review and Interim Recommendations September 2004." and "Taser Technology Review-Final Report April 2005".

I am a member of the Medical Review Panel brought together in the autumn of 2004 by the Victoria Police Department on behalf of British Columbia's Office of the Police Complaints Commissioner. The medical panel provided oversight of *medical issues* in the review namely of medical matters associated with the use of the Taser as well as interpretation of a not uncommonly associated condition called excited delirium. The latter is a state of mind begetting irrational and often violent behavior in some persons subsequently apprehended by law enforcement officers through use of the Taser. This behavior has accounted for many *seemingly* Taser-related deaths.

I have been asked to review two reports from a medical perspective: "Taser Technology Review and Interim Recommendations September 2004." and "Taser Technology Review-Final Report April 2005".

In reading these documents, I have considered as the essential question: Is the Taser safe to be used against a person where, as a consequence of their behaviour, control of that person is necessary; otherwise there appears to be danger either to the person or to others? I have set out that question and only to establish a value or baseline for my review. It is not my responsibility to answer the question in the same way that it was never the intention for the Medical Review Panel to contribute to the report directly but rather to do so indirectly as advisers.

I have taken it as my responsibility to ensure readers that the material in the report has been objectively set out following a comprehensive review of what is presently available in the medical literature in the study of devices used by the police community in creating electro-muscular disruption (EMD/CED's). Weapons said to be "non/less than lethal" like the Taser that are used increasingly often for "hands-off" apprehension when the alternative could well be a firearm.

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In completing a review of the two documents I have chosen to summarize important issues as I see them and as set out in both reports. This is but a way of reviewing the reports i.e., briefly highlighting for readers important medically related areas taken from details of the comprehensive approach used by the reports' authors, including their reviews of the literature which are in some cases appended to the final report. I believe that I have done this objectively; without favor or prejudice.

In the end, both reports have produced practical recommendations that address both administrative, training and "field" issues that overall have to do with safe use of electro- muscular disruption devices (also known in the report as Conducted Energy Devices). I am aware that the reports apply in particular to the advance Taser M26 and the Taser X 26, each employing electromechanical disruption and that one or the other is presently in the hands of policing communities across Canada and increasingly so.

Review of Interim and Final Reports:

More than one expert in the field of cardiology and electrophysiology has been consulted about the issue of the Taser shock being capable (or potentially so) of producing the fatal arrhythmia of the heart called ventricular fibrillation. There seems to be general agreement that in but one or two circumstance, most notably persons with pacemakers, the electrophysiology of the normal heart *would not* be affected by discharge of the Taser shock/energy when the weapon is properly used. The reports' recommendations include establishing a margin of safety by using a minimal number of Taser applications including careful control of continuous cycling and also recommendation of using the X-26 Taser considering it' s lower electrical output.

One is aware that it is difficult and most times impossible to assess beforehand those who might be medically at risk . Frequently persons "shocked" with the Taser had been using cocaine, a drug which causes heart arrhythmias. The public is unlikely to be aware of a dilemma; notably that in the *state of excited delirium* itself, not infrequently there are *fatal consequences*. Both excited delirium and sudden death are features of cocaine toxicity notwithstanding use of the Taser or other less than lethal methods of apprehension. This excited or agitated state often heralds police activities that frequently have required various nonlethal devices and methods of intervention, devices such as capsicum spray which before now have also been said (and incorrectly so) to be associated with sudden death. I have said more about this below in the section on excited delirium. I note that the final report has included information about this from the HECOE study (US Air Force Research Laboratory-AFRL Study) and as well further information in this area as being available from a comprehensive current British report ("Police Scientific Development Branch Further Evaluation of Taser Devices.") A report of the (UK) Defense Scientific Advisory Council is worthy of repetition and is quoted on page 42 in the British Columbia Police Complaints Commission.' s interim recommendations under the caption, Effects of Drugs of Abuse on Cardiac Function:

> *" ... cocaine, cocaethylene ... and methamphetamine...a critical review of the scientific and clinic literature revealed that these drugs still have the potential to compromise*

cardiovascular function in a way that could precipitate a life-threatening cardiac event."

I believe the authors of the British Columbia Police Complaints Commission' s reports have created a proper balance in this area as in other parts of their final report for example by explaining concerns expressed in the CBS News critical commentary on the United States Air Force Research Laboratory (AFRL) Study, also reference to the work of Dr. James Jauchem, a senior research physiologist at the AFRL together with some comments subsequently made by by Dr. Jeffrey Ho from the University of Minnesota School of Medicine. Acknowledging Dr. Jauchem's work (with the Taser and pigs) and his expression of concern that some medical monitoring might be required is likely best recognized in practice in the field using the Taser so as to confine the number of repeat cycles. As one of the recommendation on the BC report, this has merit not only in protection of the heart from arrhythmia in certain circumstances, but also in preventing tetany/exhaustion muscles of respiration and the development of acidosis. Again, while arguable that *certain* circumstances and particularly pre-existing medical conditions may not be recognized at the time, it is equally important to understand the implications of using firearms as an alternative and balance this with the police dilemma, as well remembering that the dilemma is often faced within a very short span of time.

Important information has been included in the reports as to the frequency of reported "post shock" fatal events. Often such unexpectedly sudden deaths had been distinctly separated in time from the Taser shock and so not the result of that shock according to cardiologists and electrophysiologists. This is clearly explained by Dr. Joel A Kirsch in a February 2005 letter to the Deputy Chief Coroner for Ontario and also in the comments of Dr. Jan Garavaglia, Chief Medical Examiner of Orange County (Orlando) Florida in the conjoint report and discussion/symposium sponsored by the Sheriff's Office of Orange County (OCSO) and Florida Gulf Coast University.

It is also noted that the authors of the British Columbia Police Complaints Commission' s reports have reviewed minor injuries from use of the Taser including through falls/blunt injury and from superficial burns due to the probes.

Review of References Used to Complete Reports:

I reviewed references appended to the final report and I am satisfied that they represent a comprehensive and current collection regarding cases and concerns. They include treatises both pro and con regarding police (and others e.g. United States Armed Forces) use of electro muscular disruption devices (EMD or CED as in the final British Columbia report) as a "lower-lethality" weapon for apprehending persons dangerous to themselves and/ or the public.

In the interim report of September 2004, I reviewed the abstracts of a number of studies cited in the section "The Medical Literature" beginning on page 32. Where the references in the latter report had to do with excited delirium, illicit drugs, psychosis and restraint, I had read many of them at one-time or another. However I would be remiss if I did not congratulate the authors and in

particular Sergeant Darren Laur, for the energy, enthusiasm and knowledge that has provided a most extensive review of the literature and a better understanding of the condition known as excited delirium .

Two reports of November 2004 by Amnesty International (AI) titled "Excessive and Lethal Force? Amnesty International concerns about deaths and ill-treatment involving police use of tasers" (one record for the United States, another for Canada) have been placed in the references of the final report, and are there to provide balance and an opportunity to understand the concerns about EMD/CED weapons notably the Taser. The Canadian version is relevant and timely and includes a summary of the interim recommendations made by the BC Police Complaints Commission "Taser Technology Review etc." of last September (2004). The Canadian report outlines under "Deaths in Custody," Amnesty International's concerns about health risks: ventricular fibrillation; a risk of "heart failure" together with misgiving of " a number of medical experts .... that tasers may have adverse effects on certain vulnerable groups, including those under the influence of certain recreational drugs-often the very people who have come into contact with police tasers." In the course of this Canadian AI report and in the same section, is tacit acknowledgment of a continuum over a period of years of less than lethal applications of force including restraints, capsicum spray, the prone position and which the AI report appears to recognize as being often associated with certain recreational drugs, and also related to unexpected and sudden death. For many there is a growing understanding that sudden death continues and is a distinct possibility in excited delirium notwithstanding use of a variety of non less than lethal devices and controls. Readers of the two reports of the BC Police Complaints Commission would gain more understanding of another point of view by reviewing the Canadian report by Amnesty International .

Problems for Police and Paramedics in Managing Subjects of Excited Delirium:

I have chosen to address this issue separately because at this time it increasingly appears to be the nidus of a problem. One is aware that the majority of cases with sudden death and the Taser have involved persons in states of excitement from illicit drugs: cocaine, methamphetamine and rarely phencyclidine (PCP) This has occurred both in Canadian jurisdictions along with many similar cases in the United States. I have personally critically reviewed (as an expert) several of these cases in preparation for civil litigation/trial and in so doing, at times representing counsel for the plaintiff, other times for the defendant.

The Amnesty International report indicates heightened concerns of " .. a growing number of deaths of individuals struck by police tasers." However, the Canadian version of the report does not explore this with any statistical evaluation such as correlation with increased use of the Taser in Canada. Most importantly, the Amnesty International report appears to fail to understand what has been so well put by Dr. Jan Garavaglia in citing a position paper of the National Association of Medical Examiners (USA)

" ... cocaine excited delirium is now a fatal disease, whether the police interact or not."

Dr. Jan Garavaglia's opinion recognizes an increasingly legitimate point of view that : " these individuals would have died with or without being shot with a Taser". Such deaths continue to occur despite the past history of a variety of mechanisms each constituting an unique application of nonlethal force. Thus there are several reiteration's similar to the above remarks of Dr. Jan Garavaglia scattered throughout the references in the interim and final reports of the Office of the British Columbia Police Complaints Commission. This repetition is an important emphasis on what is now being recognized increasingly as a serious medical problem i.e. excited/agitated delirium, a problem commonly born of the illicit drug (s) or of primary psychoses.

The concern of the Canadian policing community is well served by the comprehensive review undertaken by the Victoria Police Department on behalf of British Columbia's Office of Police Complaints Commissioner; by the recommendations in both reports and furthermore is also served well by the initiative of the Canadian Association of Chiefs of Police and the Canadian Police Research Center in looking critically at perceived problems with the Taser for together with the entity of the excited delirium and to promote research in each area.

Yours sincerely,

(John C. Butt CM, MD, FRCPath)

christine a. hall

May 27, 2005

British Columbia Office of the Police Complaint Commissioner
C/o Victoria Police Department
850 Caledonia Ave.,
Victoria, BC V8T 5J8
Attn: Insp. William Naughton

Dear Sirs:

Re: Taser Technology Review and Interim Recommendations, September 2004
Taser Technology Review – Final Report April 2005

I have reviewed the contents of both the interim and final reports listed above from my perspective as both a practicing emergency room physician and as an epidemiologist with research interest in sudden and unexpected death proximal to police restraint. My expertise in clinical epidemiology and my fluency with the current medical literature surrounding the condition of excited delirium allows me to review these documents in detail with an understanding of the current scientific and medical issues surrounding sudden and unexpected death proximal to police restraint.

This review stems from a response by the Victoria Police Department to 4 deaths in British Columbia proximal to the use of conducted energy devices, also known as tasers. Part of the question raised in pursuing this review was whether sufficient medical evidence exists to suggest that the use of conducted energy devices is contraindicated in persons "resisting arrest" and whether specific medical conditions such as excited delirium may put individual persons at higher risk from taser discharge.

In my opinion, the final report contains a detailed and appropriate review of the bulk of the current published and unpublished literature surrounding sudden and unexpected death proximal to police restraint and includes published perspectives from laypersons and civil liberties associations. The report recognizes and describes the complex interplay between medical conditions that may or may not be easily recognized from a distance and the use of restraint procedures including taser-type technology. The final report is a dynamic document that is a best practice reflection of what is understood medically about sudden death proximal to police restraint. This report is comprehensive, considerate and even anticipatory of the medical literature and theories surrounding these issues.

For example, the report's recommendation to limit the number of conducted energy device discharges in an attempt to mitigate the risk of relative hypoventilation addresses the current published scientific theory surrounding sudden death for individuals suffering from features of excited delirium but also recognizes postulated mechanisms for these deaths that are as yet not fully explored. The request within this document for central documentation/data management and a provincial use of force coordinator demonstrates respect for the need to understand the epidemiology of sudden and unexpected death proximal to police restraint that has been lacking in the literature to date.

Future understanding of sudden and unexpected death proximal to police restraint hinges on the recognition that excited delirium is not a voluntary condition during which a subject may be interviewed. There is currently not adequate medical technology to evaluate biochemical parameters in acutely agitated, struggling individuals. These individuals will continue to require police restraint for personal and property protection reasons in the near and distant future.

As methods of restraint have changed, each has been historically described by both lay publications and the medical literature as potentially associated with the deaths. There is no current clear understanding of the pathophysiology of these deaths nor has any specific method of police restraint been scientifically proven causal in death proximal to police restraint. This report reflects that lower lethality force options are not inherently equivalent to non-lethal force options and gives good understanding that non-lethal restraint options for certain individuals may or may not exist.

The development of methods to monitor biochemical parameters in persons resisting arrest may or may not be of future utility as there is currently no medical evidence that pre-emptive medical therapy will alter the outcome in individuals who suddenly collapse following police restraint by any methodology. Persons suffering from excited delirium in particular are anticipated to continue to experience sudden death proximal to police restraint as investigation and understanding of this condition are in a fledgling state that continues to grow. This report clearly demonstrates that the state of knowledge and subsequent adaptation of procedures is in a state of flux. Police agencies and medical practitioners will no doubt need to be forward thinking and responsive to new developments in the understanding of both excited delirium and sudden death proximal to police restraint, as outlined in this report.

Acknowledgement of the current poor understanding of the complexities of sudden death proximal to police restraint has led the authors of this report to undertake this comprehensive review of the scientific literature available; to interpret the available literature fairly and objectively, and to come forward with conservative recommendations regarding the use of all force options including conducted energy devices. It is currently impossible to predict which individuals are clearly at risk of death during police restraint and there is no medical ability to recommend one method of restraint over another. Future research, understanding and monitoring of sudden death proximal to police restraint will come through thoughtful, respectful, and objective investigation such as that provided by this report.

Sincerely,

Christine A. Hall

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INTRODUCTION

A number of force technologies, including the TASER, bean bag rounds and other projectile weapons such as the Arwen Gun have been described as "less lethal", "less than lethal", or "non-deadly".

We believe this terminology has inadvertently created a mindset among users and the public that these weapons can never have lethal effects; an expectation that is clearly unrealistic. Throughout this document, and in our supporting material, we have used the term "lower lethality" which more accurately conveys the notion that death may be associated to the use of these technologies.

We have also begun to use the term "Conducted Energy Device" (CED) rather than the trademarked term "TASER". This more inclusive term recognizes that at least two competitors are now marketing a similar product and that TASER International (TI) may no longer hold a monopoly on this type of device.

EXECUTIVE SUMMARY

Since the production of our Interim Report, the focus of the investigative team has been to provide suggested Course Training Standards in the areas of Conducted Energy Devices (CED) (i.e. TASER), Excited Delirium (ED) and Restraint Protocols (RP). These are not intended to be endpoints; rather they reflect best practices based on research available at this time. This Course Training Standards package will be made available upon its completion and is intended to support several of our recommendations in the Interim Report.

Since the Interim Report was released in September, 2004, several new studies relevant to this area have been published. The Pacing and Clinical Electrophysiology Study (PACE), although criticized because of the participation of TASER medical and technical personnel, appears to demonstrate that adequate margins of safety exist with respect to the issue of ventricular fibrillation (VF). The Human Effects Centre of Excellence (HECOE) Study, produced by the U.S. Military, also confirmed that VF was unlikely to be a risk, although it identified the potential for serious unintended consequences, *"albeit with estimated low probabilities of occurrence."*

Research done by the Air Force Research Laboratory (AFRL) confirmed several of the hypotheses present in our Interim Report, as it demonstrated that very lengthy TASER exposures (three minutes of five second on – five second off cycling) had significant impacts on blood levels of carbon dioxide, lactate, pH, and other markers. We believe this study provides support for the proposition that police should, where possible, be minimizing multiple TASER applications.

The effect that TASER application has on respiration remains an area of concern. Muscular tetany that impairs respiration may be an operative factor that has been previously unrecognized. This concern also relates to the issue of multiple usages.

Life preservation and retrieval in situations where an individual is at high risk of death proximal to restraint requires changes not just to police protocols and procedures but also the methods used by ambulance personnel and emergency room physicians. These changes require extensive research to ensure they are based on the best available information.

There are now two international research initiatives that may provide definitive answers to many of the ongoing TASER debates. In the U.K, the Defence Sciences Technology Laboratory (DSTL) has carried out experiments designed to study the effects of stimulant drugs and electrical current on cardiac tissue, potentially providing some insight as to why stimulant drug abusers make up the overwhelming majority of people who die in police restraint. **(Appendix 1).**

In the U.S., the National Institute of Justice (NIJ) is funding a three year study at the University of Wisconsin to map TASER current in the body and to monitor changes to blood chemistry and respiration.

In Canada, the Canadian Police Research Centre (CPRC) is proposing a cross-Canada epidemiological study that will focus on ED and gathering data from emergency room admissions. We believe this Canadian initiative, chosen to coordinate with other international studies, will provide previously unavailable insight into this condition and its medical management.

The Amnesty International (AI) report on the TASER makes a number of recommendations we have considered in our Final Report. Although we feel some of those recommendations have merit, we believe that blanket prohibitions do not always obtain the desired outcome.

The reasonableness of any use of force will always be determined by the situational factors. Our responsibility as a police community is to give officers the information to make the best possible decision.

METHODOLOGY

Following on our Interim Report's review of relevant medical and statistical data, this report focuses on providing support for several of our key recommendations, particularly those that relate to the critical issue of training. It was our belief that law enforcement agencies required complete "turn-key" packages for teaching their officers how to use CED's that were not vendor-produced or that employed vendor-specific language. By creating a suggested model for such training it was our hope to provide a resource others could draw upon. We do not suggest that this material is "the last word"; rather, we believe it reflects best practices based upon current information. Training will continue to evolve as research and experience continue to provide new information.

Recognizing that choices about restraint techniques were significant to managing the risk to officers and subjects in physical confrontations, we have produced suggested model training packages using new equipment and techniques, again developed in light of our research. We were sensitive to the criticism that having advocated prohibition of the maximal restraint position, it was necessary for us to provide officers with effective alternatives.

ED plays a central role in many of the sudden and unexpected deaths proximal to police restraint. We have also developed training for line officers to help them identify when these risk factors may be present and how they can best cope with this medical emergency.

In the process of creating these training packages, we have been immensely assisted by Use of Force Coordinators throughout Western Canada, representing municipal police departments, Corrections, Sheriff's, and the Royal Canadian Mounted Police. Their feedback and active participation in model testing has been invaluable. The Justice Institute of British Columbia (JIBC) assisted in facilitating these meetings and hands-on trials throughout the process.

Research on many of the areas discussed in the Interim Report continues on an international level. The NIJ (using the Interim Report as support for their proposal) has secured funding from the American government to conduct TASER studies at the University of Wisconsin. Members of our group travelled to Wisconsin to meet with the researchers and other stakeholders to provide our perspective on what kinds of data we felt would be most valuable. The discussions held by our medical panel prior to this were crucial in identifying areas of interest. In Great Britain, the DSTL continues to conduct further studies focusing on the interaction of cardiac tissue, recreational drugs, and the TASER. In Canada, the CPRC is working with Dr. Christine Hall on a proposed cross-Canada study relating to ED.

Since the Interim Report was released, several other significant events have occurred. The U.S. government released a summary of the HECOE study on the TASER **(Appendix 2).** Another AFRL study was leaked to CBS News, fuelling controversy about levels of acidosis and Troponin T (a marker used by physicians in diagnosing acute myocardial infarction and other acute coronary syndromes). Further cardiac studies, in which a TASER International (TI) medical advisor participated, were also released in a peer-reviewed medical journal (the PACE study). Finally, Amnesty International released their position paper on the TASER, encapsulating their concerns about the device's dangers and potential for abuse.

Competitors are also emerging to challenge the TI monopoly on the CED's market. Stinger Systems Inc. is currently in litigation with TI over claims of patent infringement and other issues, but is advertising a CED they claim is superior to the TI product. Requests to the company to provide a sample for evaluation have so far been unsuccessful. Stinger Systems advertises a 9.45 m (31 ft) effective range which is 3 m (10 ft) greater than the TASER, has a four dart system rather than the two probes employed by the TASER and the ability to capture audio and video during deployment. Stinger Systems also markets the device at a price significantly lower than the TASER.

This investigative team has continued to work very closely with the CPRC as that organization will continue the work that began here in British Columbia. Two members of our team will continue to work directly with the CPRC after the presentation of this report; Sergeant Laur will be working with the research group while Inspector Naughton will sit on the Advisory Panel overseeing the study.

It was not our intention that this Final Report would provide definitive conclusions about complex scientific issues. We sought to identify potentially relevant issues, to coordinate Canadian research initiatives with ongoing international efforts, and to suggest new training methodologies that work towards maximizing public safety.

OFFICER TRAINING INJURIES

In training officers to use the TASER, it has been common for instructors to expose all the trainees to a short period of exposure. Typically officers are shocked for a period of one to two seconds, rather than the full five second cycle. TI's original training material made experiencing the abbreviated shock mandatory for users, but this was subsequently changed from a mandatory requirement to one that was "strongly recommended". This mirrored previous experiences with oleoresin capsicum sprays, where direct exposure to the spray was a requirement for user certification. That requirement was subsequently removed, at least in part because of concerns raised by the Workers Compensation Board of British Columbia.

Most TASER trainers were aware of the potential for secondary injuries, particularly to the head, during this exposure and positioned officers around the trainee, supporting their weight, and preventing them from falling. What is now emerging, however, suggests there may be a potential for musculoskeletal injuries caused by the powerful muscular contraction when a CED is applied.

In December, 2004, the Arizona Republic reported the case of a Maricopa County sheriff's deputy who was suing TI claiming that he had sustained a compression fracture of his spine during such a training exposure. A doctor who examined the deputy found he had pre-existing osteoporosis; a condition which leaves people at increased risk of bone fractures. Other officers have come forward reporting training injuries that include shoulder dislocations and chipped teeth; the majority caused by falls after being shocked. Phoenix Police Department, one of the first major American agencies to equip all of its line officers with TASERs, now prohibits training exposures.

In consultation with the lead TASER instructor for the Edmonton Police Service, she advised that they have experienced three hamstring injuries as a result of TASER applications during training. These injuries were believed to have been caused by muscular contraction when the probes were placed on the hip and ankles of trainees. The Victoria Police Department has not experienced any significant injuries during TASER training, although there are occasional anecdotal reports of transient muscle soreness following exposure and one report of vertigo lasting for approximately three hours after a five second X26 TASER probe exposure.

To place these events in some context, it is relevant to note that physical training in arrest and control techniques, either at the JIBC for recruits, or in-house for serving members, has routinely resulted in broken bones, bruises and ligament tears. Hard, realistic training inevitably results in

some level of injury to the participants; however, this type of training ensures that officers are both physically and mentally prepared to deal with real-world challenges.

Given the information currently available, it is foreseeable that musculoskeletal injuries may occur during CED training and thus agencies need to revisit the issue of mandatory exposure. This also suggests that subjects exposed to a CED in a field usage may also be at risk from similar injuries, particularly if they have some underlying pre-disposing condition that makes them especially vulnerable.

The most common secondary injuries related to a probe deployment from a TASER are the minor lacerations and electrical burns at the site where the probes have penetrated the skin. Seen immediately after deployment, the probe sites are typically surrounded by small circular areas of reddened skin. Little attention has been paid to the issue of permanent scarring as a result of TASER use. We are aware of a civil suit launched in Alaska where an individual who was TASERed was successful in collecting damages for permanent scarring. We have also observed cases where law enforcement trainers who have been subjected to probe deployments have sustained permanent scarring, albeit minor in nature. The degree of scarring will be dependent upon both skin type and probe penetration and is impossible to predict prior to the event.

The risks of musculoskeletal injuries and scarring must be weighed against the benefits of TASER exposure by agencies and individual trainees. In order to make an informed decision, officers should be provided with accurate information as to possible unintended consequences.

The PACE Report

In January, 2005 Pacing and Clinical Electrophysiology; **(Appendix 3)** the official journal of the International Cardiac Pacing and Electrophysiology Society, published a peer-reviewed supplement entitled "Cardiac Safety of Neuromuscular Incapacitating Defensive Devices". This study was conducted by Dr. Wayne McDaniel of the University of Missouri-Columbia, with the assistance of Dr. Robert Stratbucker; the medical advisor to TI, Max Nerheim; an electrical engineer employed by TI and James Brewer, a consultant from Minneapolis. Their research was funded, in part, by a grant from the Office of Naval Research.

This study was focused on the issue of VF and the hypothesis of the researchers was that "*the induction of VF would require significantly greater discharge levels than delivered by electrical NMI (neuromuscular incapacitation) devices fielded by law enforcement agencies.*"

This study utilized adult domestic pigs chosen to simulate human bodyweights of between 30 kg (66 lb) and 120 kg (265 lb). Researchers used a device that provided the same waveform and pulse duration as the X26 TASER, but which could be adjusted to provide increasing levels of electrical charge, far beyond that which can be produced by the X26. Power levels were increased until VF could be reliably induced, and the results recorded.

> *"This study confirmed the cardiac safety of an experimental NMI device emulating the performance of commercially used devices. An NMI discharge that could induce VF required 15-42 times the charge of the standard NMI discharge. Furthermore, this study demonstrated a safety index strongly correlated with increasing weight. In addition, the observation of the hemodynamic stability of the animals suggests that these devices may be safely applied multiple times if needed. Discharge levels output by fielded NMI devices have an extremely low probability of inducing VF."*

Predictably, the PACE report almost immediately came into question because of the involvement of Dr. Stratbucker. Some of the criticism came from an unexpected direction, namely an investment research organization, Gradient Analytics. Gradient suggested that salary and stock options given to Stratbucker by TI could taint results and lead to an apprehension of bias. Gradient also questioned research protocols that did not include such potentially relevant factors as drug ingestion and the elevated heart rate provoked by physical struggle.

The National Institute of Justice Study

The NIJ is the research and evaluation branch of the U.S. Department of Justice. Its role is to provide objective information to participants in the criminal justice process, and it funds research in a number of different areas.

The NIJ is actually funding two programs that are relevant to CED's. The first is a multi-centre trial that will record the number and severity of injuries produced by law enforcement officers using lower lethality devices such as TASERs, rubber bullets and bean bag projectiles. The Wake Forest University Baptist Medical Center is receiving $140,000.00 from the NIJ for the study, led by Dr. William Bozeman.

The study is utilizing twelve different cities as study sites, where emergency room physicians will assess and report on injuries related to lower lethality weapons deployment. The researchers anticipate between 750 to 900 individuals will be examined in the course of the study; the first injury epidemiology study of its kind. This study should provide valuable insight into how tactical choices relating to the deployment of lower lethality weapons affect injury rates.

The second program is the one most immediately relevant to CED's and is being conducted at the University of Wisconsin **(Appendix 4)**. Unlike the British study, the Wisconsin study is utilizing live animals (swine) and is focusing on mapping the path of TASER current in the body. Using models that will most closely simulate field applications, this study should provide definitive answers about how much, if any, electrical energy is able to reach the heart and the possible effects. This study will also examine issues such as fibrillation thresholds, the impact of a variety of stimulant drugs, including cocaine and methamphetamine, and changes in blood chemistry.

Two members of our investigative team travelled to Wisconsin to meet with the research team, as well as stakeholders from the NIJ, the U.S. Military, and TI. This study is being funded entirely through the NIJ. The final report from this research is scheduled to be produced in mid-2007.

The HECOE Study

This report was produced for the Joint Non-Lethal Weapons Directorate HECOE by a variety of civilian contractors. HECOE was established by the U.S. Air Force Research Laboratory and the Joint Non-Lethal Weapons Program.

The HECOE Study was designed to assess the effectiveness and risk characterization of the M26 and X26 TASER. It did not conduct any new or groundbreaking research; rather, this was an assessment based on existing data.

"Overall, the results indicate that the use of the TASER M26 and X26, as intended, will generally be effective in inducing the desired temporarily incapacitating effect without presenting a significant risk of unintended severe effects. Although likely to be uncommon, some severe unintended effects might occur."

"The occurrence of in-custody deaths has been reported in conjunction with use of TASER devices. However, there are several arguments against any predominant role of EMI (Electromuscular Incapacitation) in arrest-related deaths. In previous epidemiological reports, deaths were often attributed to illicit drug intoxication in suspects. Although these reports address incidents involving EMI waveforms different from those of the M26 and X26, drug intoxication has been associated with in-custody deaths under a number of circumstances, regardless of how the subjects were subdued. Contemporary medical opinion supports the view that the drug intoxication itself causes or predisposes one to underlying vulnerability. Based on the documentation and research reviewed, this report concludes that EMI is likely not the primary causative factor in reported fatalities."

The HECOE study goes on to recommend further study on EMI-drug interactions to increase confidence about risk assessment in heterogeneous populations with *"uniquely sensitive members"*. The ongoing British research should provide more information on this issue by the summer of 2005.

This study also made estimates on the likelihood of various events occurring when a TASER was deployed. The estimated likelihood of complete electromuscular disruption was from 80%-56%, with the chances decreasing with distance. Likewise, partial electromuscular disruption was estimated at 6%-4%, again decreasing with distance. These could be characterized as the intended effects. This study also examined the risk of unintended effects. The risk of a probe striking the eye was between 0.01% and 0.04% possibly increasing with distance. Injuries due to falls were estimated at 0.15%-0.10% decreasing with distance. Seizures, although not observed in field usages, were believed to have a probability of 0.7%, based on a worst case scenario. This worst case scenario was based on a probe striking the head area with an accompanying electrical exposure that exceeded the seizure threshold.

The HECOE report concluded that other effects such as *"dart localized burns"* were of minimal severity. This issue was discussed earlier. The HECOE conclusion may reflect the different values associated with military applications as opposed to deployment by law enforcement.

On the issue of cardiac effects:

"Ventricular fibrillation was not expected to occur in otherwise healthy adult populations, although data are too limited to evaluate probabilities for potentially sensitive populations or for alternative patterns of exposure."

Air Force Research Laboratory Study

In February, 2005, CBS News reported on a study done by the U.S. Air Force, which it claimed proved that repeated TASER shocks led to heart damage in pigs. This was based on findings that the pigs experienced a rise in blood acid levels and the enzyme Troponin T, which is a marker used by physicians in diagnosing acute myocardial infarction and other acute coronary syndromes. Initially thought to be the HECOE report, the quoted study was actually the work of Dr. James Jauchem **(Appendix 5).** CBS News quoted Georgetown University Hospital cardiologist Dr. Charles Rackley with respect to the significance of the findings:

> *"Asked what his diagnosis would be if a patient came to him with these blood levels, Rackley says, "My initial impression would be that meant some heart muscle damage, or heart attack."*

It should be noted that the pigs in this study were shocked 18 times, when the majority of field exposures in humans is far less, and none of the pigs died. Still, Rackley believes blood levels like this in a human would be an emergency.

> *"The combination of the acidosis as well as the heart muscle damage would put this patient at high risk of developing ventricular fibrillation or sudden cardiac death."*

TI issued a response the following day, having obtained a contrary opinion from Dr. Jeffrey Ho, an Assistant Professor of Emergency Medicine at the University of Minnesota School of Medicine.

> *February 10, 2005*
>
> *As a practicing emergency physician who has treated subjects that have come into the emergency room after long protracted struggles with police and as a physician who is investigating deaths proximal to restraint I have been asked comment on the recent CBS broadcast regarding testing of Troponin levels in animal subjects.*
>
> *I think the concept of acidosis and the level of blood acid needs to be put into perspective. Can acidosis put you at risk for sudden death? Yes. Can elevated blood acid put you at risk? Yes. Do either or both always result in ventricular fibrillation or sudden cardiac death? Of course not. The concept of sudden death, especially in the context of "in-custody" appears to be a multi-factoral event (usually involving a very stimulated, hyperactive subject, either on illicit stimulant or off their mental health medicines or with a congenital cardiac defect or perhaps all of the above).*
>
> ***It is not just due to elevated blood acid. To give the impression that any time your blood acid or Troponin T elevates that you are somehow at risk of immediate death does not give the whole story and actually misstates the known scientific facts.*** *As I have stated before, exercise can induce a Troponin T leak in the skeletal muscle. It also induces acidosis (see Kowalchuk et al.* ***Factors***

Influencing Hydrogen Ion Concentration in Muscles after Intense Exercise. *J of Applied Physiology 1988; 65 (5):2080-2089) which is a normal and expected response.*

In the Air Force Study, it is not surprising that there is some measurable Troponin T and elevated blood acid after stimulation of the skeletal muscle. In fact, Kowalchuk's article demonstrated levels that exceeded the Air Force Study (Air Force Lactate: 15; Kowalchuk's Lactate; 47; Air Force pC02: 100; Kowalchuk's pC02: 106) in humans after only 30 seconds of exercise and demonstrated that it took about 9.5 minutes for them to recover. I'm confident that most humans can perform 30 seconds of exercise without dropping dead UNLESS there are other factors at work such as an overdose of a stimulant, congenital disease, etc, which are all factors associated with or without the use of a TASER device.

Jeffrey D. Ho, MD, FACEP
Assistant Professor of Emergency Medicine
University of Minnesota School of Medicine
Minneapolis, Minnesota

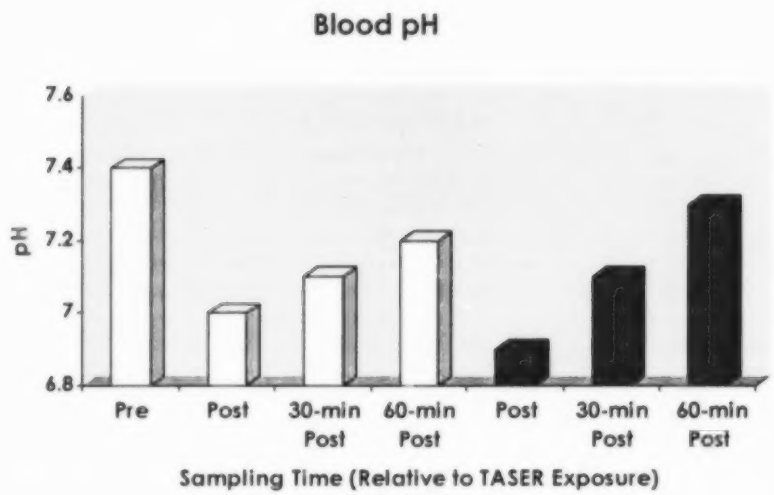
The investigative team had been in contact with Dr. James Jauchem, the Senior Research Physiologist in the Human Effectiveness Directorate at the AFRL, prior to the release of the CBS story. Dr. Jauchem was the author of a presentation entitled "Effectiveness and Health Effects of Electro-Muscular Incapacitating Devices", which was publicly released in November, 2004. The presentation focused on both the effectiveness of CED systems and the health effects that could be anticipated.

Dr. Jauchem's test protocol involved pigs because pigs possess a ratio of heart size to body weight similar to humans, their coronary artery distribution resembles ours, and they are also susceptible, like humans, to ventricular fibrillation.

In this case, these animals were exposed to repeated cycles from an X26 TASER using five seconds of application followed by five seconds of rest for a period of three minutes. This meant the animals were TASERed 18 times within that three minute period. After a delay of one hour, a second three minute exposure period, identical to the first, was added (refer to shaded bars on bar chart).

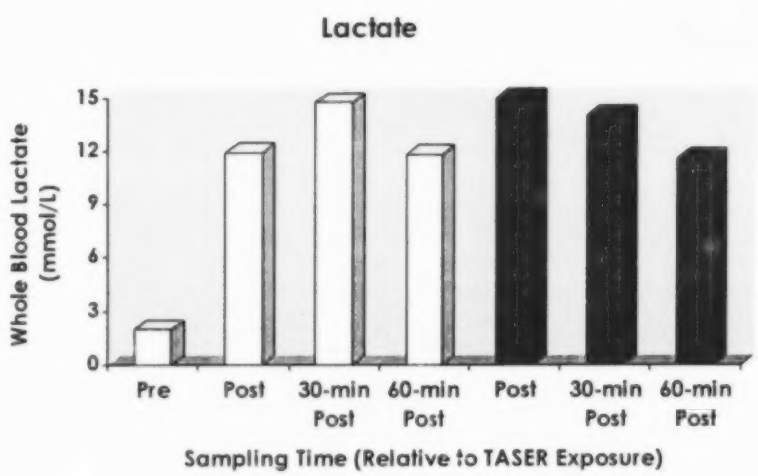
Dr. Jauchem made a number of observations relating to blood chemistry. With respect to pH, he noted that blood became more acidic after the three minute application, returning toward normal levels one hour after exposure.

PORCINE WHOLE BLOOD pH PRE AND POST APPLICATION OF TASER



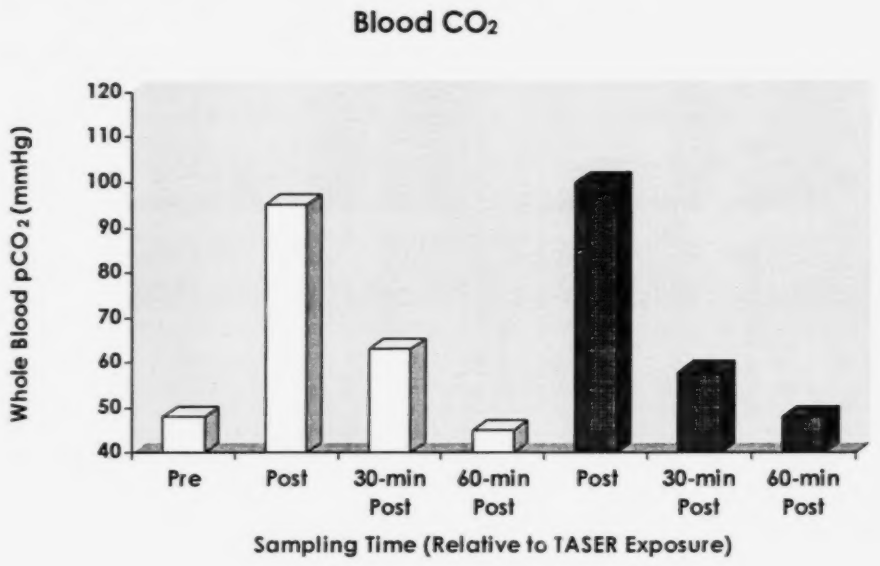
He also noted highly elevated lactate levels that returned to baseline values more slowly.

PORCINE WHOLE BLOOD LACTATE LEVELS PRE AND POST APPLICATION OF TASER



Blood carbon dioxide levels also rose immediately following the TASER application, but declined to normal within sixty minutes.

PORCINE WHOLE BLOOD PCO_2 PRE AND POST APPLICATION OF TASER



The effect on levels of Troponin T was not publicly released, but was subsequently obtained by the news media.

Dr. Jauchem reached a number of conclusions, the first being that the X26 TASER was successful in producing the desired effect, i.e. incapacitation. Using an experimental device that allowed greater power levels than the X26, he found that varying the pulse amplitude and duration over several orders of magnitude resulted, unsurprisingly, in increased muscle contraction. He also found that maximum contraction occurred with a minimum probe spacing of 20 cm (8 in). In relation to the blood chemistry changes, Dr. Jauchem concluded that *"some medical monitoring of subjects may be required."*

The issue is the extent to which Dr. Jauchem's work can be usefully extrapolated to law enforcement scenarios which are highly unlikely to involve such a prolonged series of shocks. Nonetheless, we believe this work is very valuable and supports a number of preliminary hypotheses about the role of blood pH, respiratory impairment, and sudden in-custody death.

The Amnesty International Report

In the fall of 2004, Amnesty International (AI) released **"Excessive and lethal force? Amnesty International's concerns about deaths and ill-treatment involving police use of TASERs" (Appendix 6).**

This report documents AI's concerns about the TASER and the potential for misuse. It also focuses attention on what we believe is one of the most critical issues; a precise delineation of when it is appropriate for police to deploy a CED.

> *"There is also evidence to suggest that, far from being used to avoid lethal force, many US police agencies are deploying TASERs as a routine force option to subdue non-compliant or disturbed individuals who do not pose a serious danger to themselves or others. In some departments, TASERs have become the most prevalent force tool. They have been used against unruly schoolchildren; unarmed mentally disturbed or intoxicated individuals; suspects fleeing minor crime scenes and people who argue with police or fail to comply immediately with a command."*

> *"TASERs have been described by many police departments as "filling a niche" on the force scale. However, Amnesty International is concerned that deployment of TASERs, rather than minimising the use of force, may dangerously extend the boundaries of what are considered "acceptable" levels of force. While the organization concedes that there may be limited circumstances under which TASERs might be considered an alternative to deadly force, there is evidence to suggest that measures such as stricter controls and training on the use of force and firearms can be more effective in reducing unnecessary deaths or injuries."*

The AI report calls for law enforcement agencies to suspend the use of electro-shock devices, pending an independent inquiry into their use and effects. Where agencies decline to suspend use, Amnesty recommends that the use of TASERs be strictly limited to situations where the only other force option is deadly force.

The investigative team believes that a number of AI's recommendations with respect to accountability and contraindications are valuable and are substantially in line with many of our own recommendations. We support a number of their suggestions with respect to administrative accountability and public reporting on use of force.

We also believe that AI has ***significantly downplayed*** the risks associated with officers attempting to subdue an "unarmed" individual, and the potential for serious injury to both parties in arrest situations even where no weapons are used. This fails to reflect the reality that officers are often called upon to control individuals who may be larger, stronger and younger, and who have received formal or informal training in unarmed combat, either in a martial arts school or a prison yard. The implication that an unarmed individual cannot pose a serious risk is a dangerous fallacy.

The Canadian branch of AI also published a report in conjunction with the American study. This detailed significant incidents involving the TASER in a Canadian context, and the recommendations mirrored those in the American document **(Appendix 7).**

The OSCO Study

This study was an unfunded research project; a collaboration between the Orange County Sheriff's Office (OSCO) and the Florida Gulf Coast University **(Appendix 8).** It was aimed at identifying the effectiveness of various lower lethality options employed by police and examining the potential for force escalation.

The OSCO Study found that lower lethality munitions such as the bean bag round produced injuries in 80% of the instances where they were deployed; the majority being bruises or abrasions from the projectile. They reported eight deaths in 373 deployments. Conventional impact weapons like batons also produced blunt trauma injuries, and had a very high potential for escalation of subject resistance if they were not immediately effective. Chemical agents had a very low associated injury rate, and the OSCO Study found them to have a lower failure rate (12%) than other studies. Conventional defensive tactics-officers using hand to hand techniques to subdue subjects were ineffective 29% of the time and **resulted in the largest number of subject and officer injuries.**

OSCO found the TASER to be effective in 77-95% of the cases studied, with the effectiveness varying greatly between divisions. Specialized units had much lower failure rates (11%) than patrol (22%). The study's authors speculated this may have been the result of specialized units deploying the TASER much earlier in an event where there was an expectation of resistance and thus providing less opportunity for the subject to move out of the 21 foot range. Most significantly, the study found that the TASER had the highest level of de-escalation (subjects were less likely to fight harder against arrest) and provided a substantial deterrent effect even when not used. OSCO documented one death associated to the TASER in 870 deployments studied.

The OSCO Study identified 18 instances in a one year period where subjects were subdued with a TASER in circumstances when deadly force was warranted. Using the figure of $100,000.00 as the cost for deadly force litigation (not including any damages that may be awarded), OSCO estimated that this had saved $1.8 million in legal costs.

The OSCO Study may be most valuable for highlighting that many of the lower lethality options available to police have high potential for causing blunt force trauma and do not necessarily terminate the physical confrontation. This may be why these tools are used so infrequently in a Canadian context.

Madison Police Department TASER Report

This report was produced by the Madison, WI Police Department (MPD) at the conclusion of a pilot program that saw TASERs introduced into their inventory in the summer of 2003 **(Appendix 9)**. This study further illustrates the value of comprehensive reporting in a use of force context.

This study found that in 92 TASER deployments the device was successful in producing incapacitation 77% of the time. This is in line with similar studies across North America. This study also documented six cases where the TASER was used to subdue suspects whose actions would have justified the use of deadly force.

The Madison report documents two significant secondary injuries as a result of suspects falling with one individual requiring seven stitches to close a laceration. It also noted a reduction in officer injuries during physical confrontations, although with the caveat that this reduction could not be entirely attributed to the TASER alone.

The key findings in the report were summarized as follows:

- *MPD's deployment of the TASER has reduced injuries to officers and suspects resulting from use-of-force encounters;*
- *MPD's deployment of the TASER has reduced MPD officers' utilization of deadly force;*
- *The TASER has proven to be a safe and effective use-of-force tool;*
- *MPD officers are deploying the TASER in an appropriate manner*

RUGGIERI-Lethality of TASERS

On February 25th, 2005, James Ruggieri made a presentation to the Annual Meeting of the American Academy of Forensic Sciences **(Appendix 10)**. The title of his presentation was Lethality of TASERs.

This presentation is apparently being prepared for publication, but at the time of this writing we were able to access only the PowerPoint presentation. Mr. Ruggieri's work has not yet been peer-reviewed.

Mr. Ruggieri asserted in his presentation that a review of available documents had led him to conclude that there were critical technical errors made by TI in their assessment of electrical risk. He went on to express the opinion that the devices were indeed capable of killing people and that the electrical charge from the M26 fell into the zone that the International Electrical Commission standards described as causing ventricular fibrillation 50% of the time. Ruggieri goes on to hypothesize that delayed VF may be the cause of some TASER-related deaths; with medical examiners mistakenly believing that VF precipitated by electric shock must be

instantaneous. Ruggieri does not apparently consider the impact of metabolic acidosis, ED or other factors. Ruggieri does quote from the Podgorski and Roy study referenced in our Interim Report, which utilized stun guns in an effort to produce cardiac arrhythmias in pigs.

We noted in his presentation a number of references to J. Reilly and his book *Applied Bioelectricity*. We contacted Mr. Reilly and sought his comments on the Ruggieri presentation. Mr. Reilly provided a detailed response, commenting that "it appears that some inappropriate conclusions have been circulated relative to the information in Mr. Ruggieri's slides." Mr. Reilly, it should be noted, was a participant in the HECOE Study, which had concluded that the risk of VF in a healthy population was very low. We have reproduced, with his permission, Mr. Reilly's response in full **(Appendix 11)**. His conclusion:

> *"In view of these facts, neither the M26 nor X26 TASER is expected to produce a VF hazard when applied to the thorax of healthy human adults. I am not aware of scientific investigations of TASER safety in potentially sensitive people (e.g. the ill or under the influence of drugs)."*

TI also responded to Ruggieri's statements, asserting that he had wrongly applied the IEC standards, utilizing one that is applicable to AC currents in the 15-100 Hz range, rather than pulsed DC current with a frequency of approximately 50,000 Hz.

Relevant to Ruggieri's assertions with respect to delayed VF was an opinion obtained by Dr. J. Cairns, the Deputy Chief Coroner for Ontario **(Appendix 12)**. Dr. Cairns asked Dr. Joel Kirsh, Staff Cardiologist at the Hospital for Sick Children in Toronto for his opinion on the cardiac safety of the TASER. Dr. Kirsh specifically addresses the concept of VF occurring sometime after exposure to electrical current.

> *"The time course of deaths reported as being possibly related to TASER use is not typical of the usual clinical picture that experienced cardiac electrophysiologists have observed over several decades of proactive testing for ventricular arrhythmias. During such tests, the ventricle is incrementally paced with progressively shorter extrastimuli until such time as tissue refractoriness is reached, or an arrhythmia is induced. Such experimentally induced arrhythmias are observed as occurring immediately with extrastimuli and there is no known electrophysiologic mechanism to explain any delayed induction of ventricular arrhythmias, whether minutes or hours following the extrastimuli."*

MEDICAL REVIEW PANEL

One of the objectives of the investigative team was to bring together a number of medical professionals and individuals from different fields to discuss the current research on CED's. The following individuals participated in this meeting on Oct. 27th, 2004:

Dr. J. Butt (Forensic Pathologist)
Dr. D. Docherty (Exercise Physiologist)
Dr. R. Leather (Cardiologist)
Dr. S. Lohrasbe (Forensic Psychiatrist)
Dr. A. MacPherson (Vice Chief of Emergency Medicine)
Dr. V. Sweeney (Neurologist)
Mr. C. Lawrence (Trainer with the Ontario Police College)
Mr. P. Leslie (District Superintendent for the BC Ambulance Service)
Mr. S. Palmer (Executive Director of the Canadian Police Research Centre)
Mr. M. Rutledge (Advanced Life Support Paramedic)

The purpose of this panel was not to draw conclusions about the safety of the TASER or other CED's, rather it was an effort to bring together a multi-disciplinary group that could identify relevant issues for further study. This meeting was timed to precede the NIJ meeting in Wisconsin, so that we would have the panel's input prior to attending.

The panel members had been supplied with all the research material the investigative team had gathered to that time. The panel was briefed on the methodology of the investigation and then given a demonstration of both the M26 and X26 TASERs prior to open discussion.

There was consensus on the issue that sudden and unexpected death proximal to restraint is caused by a variety of factors, not a single precipitating issue. Risk factors identified included significant amounts of acidosis which affect cardiac contractility, respiratory muscle impairment, rhabdomyolysis (the destruction of skeletal muscle tissue (from traumatic injury and/or excessive exertion) that is accompanied by the release of muscle cell contents into the bloodstream) hypoglycaemia, and high levels of adrenaline.

With respect to ED, it was observed that this is not a single entity, but rather a "symptom cluster" that often occurs in hospital settings. It was also noted that cocaine and methamphetamine abuse overlap with mental disorders and produce paranoia and control over-ride, where the subject feels a loss of control over their thoughts and actions. Because these drugs can over-

stimulate already delirious patients, increased fatality rates are seen in hospitals without the presence of TASERs or other lower lethality weapons.

Both doctors and ambulance personnel identified that a period of tranquillity or "stalling" following restraint, but prior to cardiac arrest, may be the best time to intervene medically. By using a portable ISTAT device (a tool which measures blood gas levels) ambulance personnel can observe pH, lactate levels, CO_2 levels, electrolytes, and other factors to determine what measures are most appropriate. Chemical restraint (the use of tranquilizing drugs) was discussed and was felt to be a very important tool in life preservation. It was noted that paramedics in Calgary, AB and Toronto, ON employ chemical restraint on a regular basis and that a prospective study on this is being proposed.

It was clear from the discussion that the development of new medical protocols for dealing with ED hinges on research that will confirm a number of the existing hypotheses. It was agreed that a national or international standard of evaluation and information gathering would be the preferred method for obtaining this data.

Based on this, the investigative team moved forward to propose the inclusion of blood gas monitoring in the University of Wisconsin research project to provide data on acidosis, CO_2, and other factors. As discussed, members of the investigative team will continue to support the CPRC-sponsored epidemiological study of ED across Canada.

Respiratory Impairment/pH Changes in Multiple Applications

Depending on probe location in the upper torso, it appears likely that the muscular tetany produced by a TASER deployment could impair a subject's respiration. TI acknowledges this in their most recent instructor-level teaching material. Whether such impairment would occur in a push stun deployment to a limb is a matter of speculation. If breathing is stopped or impaired during the five second cycle this could effect both CO_2 and pH levels. If the TASER is cycled continuously for 15-20 seconds the effects could be expected to increase.

As discussed in our Interim Report, the issue of respiratory impairment due to restraint appears to play a role in some of the deaths studied. Respiratory impairment becomes particularly crucial when the weapon is used or restraint is applied during or at the end of a prolonged physical struggle. The ability to breathe freely is critical as the body tries to return to homeostasis and compensate for increased levels of CO_2.

Based on Dr. Jauchem's research, it would appear that prolonged TASER applications (three minutes of five seconds on - five seconds off cycling) can produce significant lowering of pH levels in pigs. This may be the interaction of respiratory interruption along with high levels of muscular contraction.

In case studies, the investigative team has observed instances where TASERs were used multiple times; sometimes against individuals who were already secured. We note that AI has called for controls on multiple applications including:

> *"8. Repeated shocks should be avoided unless absolutely necessary to avoid serious injury or death.*
> *9. Departments should introduce guidelines which prohibit the application of prolonged shocks beyond the five second discharge cycle."*

There will be situations, particularly in areas where back-up officers may be distant or unavailable, where multiple applications are necessary to control violent subjects. **Training protocols, however, should reflect that multiple applications, particularly continuous cycling of the TASER for periods exceeding 15-20 seconds, may increase the risk to the subject and should be avoided where practical.** Conventional use-of-force theory dictates that officers abandon any particular tactic after it has been employed several times without achieving the desired result (i.e.: control of the subject). If multiple TASER applications have not succeeded in gaining control, the officer should reassess and consider another force option or disengagement.

Conversely, recognizing that prolonged struggle heightens the risk to both the officer and the subject, it may be appropriate to use a TASER as soon as it becomes clear that physical control will be necessary and that negotiation is unlikely to succeed. **A single TASER application made before the subject has been exhausted, followed by a restraint technique that does not impair respiration may provide the optimum outcome.**

Pregnancy

There is currently no peer-reviewed research on the effects of CED current to a pregnant woman and her fetus. The only report located specific to pregnancy was a 1992 medical report regarding a woman, 12 weeks pregnant, who began to miscarry seven days after being exposed to an early model TASER.

TI's medical staff have theorized that the womb and amniotic fluid provide a "Faraday shield" effect that would prevent electrical current from reaching the fetus, and they have conducted one unpublished animal study that found the X26 TASER did not induce miscarriage in two pregnant pigs. There have been several out-of-court settlements involving pregnant women, but these have not produced any independent research outcomes.

Pregnancy is another situational risk factor that has to be evaluated in the entire context of a use-of-force event. A TASER is clearly preferable to a firearm, if the situation warrants deadly force, but more difficult calculations have to be made where physical force is necessary to resolve a situation that does not require a firearm. The risk from secondary injuries, such as falling, obviously takes on more significance when dealing with a pregnant subject.

Body Weight and Size

Scientific literature has long recognized that body mass directly impacts on the effects of electrical current on an individual. The PACE Study is the most recent confirmation that those with a lower body weight, such as children, have lowered margins of safety when exposed to an electrical current. It found that a 30 kg (66 lb) pig had a safety ratio of 15:1 (with respect to ventricular fibrillation) when exposed to X26 TASER current. A pig with a body mass of 117 kg (258 lb) had a safety ratio of 42:1 before fibrillation could be induced.

However, public concern about the use of TASERs against children and the elderly does not rest solely on the issue of electrical safety. There are documented cases of TASERs being used against individuals who could not pose a significant physical risk, either because of size or age.

where that use of force was clearly inappropriate. Appropriate training, administrative accountability, and genuine consequences to inappropriate actions are the best safeguards against these kinds of abuses.

Because, as we have discussed, blanket prohibitions against TASER use on specific groups can be counterproductive, the test in every case remains one of reasonableness.

THE TASER AND THE CANADIAN USE OF FORCE MODEL

A number of previous Use of Force Models have employed a linear continuum, with police presence at the lowest end, and deadly force at the highest. Although easily understandable, this linear model was criticized for implying that police would have to move through each step on the continuum until they found an option that was successful. The circular Canadian Use of Force Model was chosen, in part, because it represents the range of options available to an officer and allows situational factors to dictate the appropriate choice of force option. All force options on the Canadian Model range in their use from implied force (i.e.: presence, stance, etc) to lethal force (i.e.: discharge of a firearm or sensitive target applications with lower lethality weapons).

Because the TASER has been classified as an Intermediate Weapon along with OC spray, bean bag shotgun rounds, and the baton, there has been confusion in the public and the police community about when the TASER is the appropriate force option. Should OC spray be used first in a physical confrontation, and then the TASER if that fails? Is it appropriate to use the TASER in circumstances when police are confronted by passive resistance, where a subject offers no active resistance, but rather sags to the floor and refuses to move? What about a drunk driver who clings to the steering wheel and refuses to exit his vehicle?

All decision-making about force options-as suggested by the circular Canadian Use of Force Model-is driven by situation and context. **The variety and complexity of the circumstances that may confront an officer make it impossible for any policy to encompass every possible scenario**. We can, however, suggest general guidelines, recognizing that they are not iron-clad; rather they are general principles which will be diverse in their application.

1. **With respect to CED's, including the TASER, we are recommending, subject to situational factors, that they not be used against subjects who are demonstrating only passive resistance.**

2. **For subjects who are displaying active resistance, those who are resisting an officer's efforts to take them into custody without attacking the officer, where an officer believes the use of a CED is appropriate we are recommending that CED's be used in a push stun mode only.**

3. **In situations where officers are confronted by active resistance, assaultive resistance, or the threat of grievous bodily harm or death, where an officer believes that the use of a CED is appropriate we are recommending that CED's be used in either a push stun or probe deployment mode.**

These recommendations should be read in context with the previous discussion of medical contra indicators.

PROVINCIAL USE OF FORCE COORDINATOR

This review of CED's came at the direction of the Office of the Police Complaint Commissioner, in the wake of four deaths in the Province of British Columbia associated to the use of the TASER. The controversy over the use of the TASER closely mirrors similar debate over the safety of OC spray when it was first introduced in the 1980's. It is interesting to note that impact weapons, such as the bean bag shotgun round and the Arwen gun attract much less controversy, at least in part because the mechanisms of injury from blunt trauma are well-understood even outside the medical community.

New lower-lethality technologies will continue to be developed, as police agencies continue to search for alternatives to deadly force. How the police community assesses and adopts such new technologies is now of more pressing concern.

Traditionally, technological innovations have been embraced piecemeal, with individual agencies doing their own research and evaluation, and then making a decision about whether or not to adopt a specific weapon. Often a single agency will deploy with a new weapon, while other agencies adopt a "wait and see" approach.

Use of Force Coordinators in B.C. have consistently advocated for the creation of a Provincial Use of Force Coordinator. Although this position is included in the Provincial Use of Force regulations, it has never been filled. This investigative team strongly believes that the TASER experience has once again highlighted the need for such a position as indicated in the Oppal Report (1994: Recommendation #196).

There is an urgent need for a single point of contact resource that is accessible by all police agencies in the Province. This Provincial Use of Force Coordinator would be responsible for evaluating and assessing both new and existing technology and ensuring that agencies have access to best practices in all use of force areas.

TASER/CED FAQ's

1. ***Why use a TASER instead of OC spray?***

OC spray can be an effective tool, but it has a much lower rate of effectiveness than the TASER. OC spray also tends to fail most predictably on individuals who are emotionally disturbed, under the influence of stimulant drugs, or highly motivated. Users also have to be concerned about the contamination of bystanders and other officers. Outdoors, wind and rain may render OC spray useless. The effects of OC spray linger for extended periods of time, and decontamination can be a long process. The appropriate choice between the two weapons will be situationally driven.

2. ***Why TASER someone who is suffering from Excited Delirium? Why not just leave them to calm down on their own?***

ED is a **medical emergency** that demands intervention. Restraint of the individual is a necessary pre-condition for treatment. In many cases, those suffering from ED are found running through traffic or otherwise placing themselves and others at risk and would have to be restrained in any event. Where individuals are contained in a room, officers should use the time to formulate a plan for entry and restraint that allows them to immediately turn the person over to ambulance personnel.

3. ***Why TASER someone suffering from Excited Delirium who could be physically restrained by several police officers working together?***

The prolonged struggles that typically characterize efforts to physically control individuals suffering from ED significantly increase the risk to the subject. Prolonged struggles worsen things like blood acidosis, lactate build-up, and levels of carbon dioxide. They also have the potential to compromise the subject's breathing, leading to hypo-ventilation, which increases all those negative effects.

Immediate intervention with a single TASER application, followed by appropriate restraint techniques that do not compromise respiration and a speedy handover to medical personnel may represent the best possible scenario.

4. *Why are you recommending officers minimize multiple TASER applications?*

The Air Force Research Laboratory study shows that a very large number of TASER applications (18 exposures of five seconds each in three minutes) have a negative effect on pH, carbon dioxide levels, and lactate levels. Until the University of Wisconsin Study is able to provide definitive answers, we believe the Air Force study demonstrates that multiple applications increase risk factors we identified in our Interim Report. Multiple applications also have the potential to impair respiration, which we know is linked to those known risk factors.

Although multiple applications may be tactically required, particularly in remote areas where back-up is distant or unavailable, the risks associated should be included in an officer's decision-making process.

5. *What role does restraint play in sudden and unexpected death proximate to restraint?*

Subjects who struggle with police are almost always restrained in a face-down position. If subjects are pinned down with a great deal of weight placed on their shoulders and back for a long period of time it may hamper their ability to breathe rapidly enough. This state of hypoventilation means the subject can still breathe, just not at the level their body requires to return to equilibrium. Police may be misled by the fact the subject can still speak, indicating a clear airway, which does not necessarily mean they can breathe at an adequate rate.

6. *What about bean bag rounds and Arwen rounds? How do they fit in?*

The OCSO Study, cited in this report, indicates that these kinds of impact munitions have all the anticipated risks associated with tools that rely on blunt trauma for effect. There are also fatalities and serious injuries directly associated to the use of these weapons, especially when subject movement makes targeting very difficult. Shotguns and Arwen guns are large and can be difficult to deploy in indoor settings.

Because these rounds can be fired at distances far exceeding the effective range of the TASER (21 ft) they perform a role that the TASER cannot duplicate. Relying on blunt trauma and pain compliance for effect, they may not be effective against individuals who are high on stimulant drugs or the effects of ED.

7. Why TASER someone who is unarmed?

The question implies that being unarmed is the equivalent to be being harmless. The OCSO study confirms that physical control tactics are the most likely to fail in controlling a non-compliant subject, can provoke escalation, and put the officer at significant risk of injury. This risk increases when the subject has formal or informal combative training, when the subject is larger and stronger than average, and when the subject is younger than the arresting officer.
The reasonableness of the use of the TASER over any other control tactic must always be judged in light of all the relevant situational factors.

8. Are TASERs being widely misused by police?

Two police officers in British Columbia have been charged with assault for incidents involving a TASER. One of those officers has pleaded guilty, and the other is awaiting trial. **The absence of a Province-wide use-of-force reporting system and inadequate or absent administrative oversight increases the potential for abuse**. Accountability in many instances remains below a level we believe is acceptable. The TASER has more built-in accountability than any other weapons system; the challenge is for organizations to utilize that information properly.

9. Does the TASER cause ventricular fibrillation?

Ventricular fibrillation from electric shock is characterized by the immediate collapse and death of the subject. In the vast majority of cases where death is associated to the use of the TASER occurs it happens some period of time after the application. This fact, plus numerous studies (some TASER-funded) seem to confirm that the risk of death from VF is very low.

Cardiac complications may stem from other identified factors, including acidosis, stimulant drug abuse, and underlying heart disease.

GLOSSARY OF TERMS

CED:	Conducted Energy Device
CPRC:	Canadian Police Research Centre
DSTL:	Defence Sciences Technology Laboratory
ED:	Excited Delirium
EMI:	Electro-Muscular Incapacitation
HECOE:	Human Effects Centre of Excellence
ISTAT:	A medical tool which measures blood gas levels
NMI:	Neuro-Muscular Incapacitation
NIJ:	National Institute of Justice: the research and evaluation branch of the U.S. Department of Justice
OSCO:	Orange County Sheriff's Office
PACE:	Pacing and Clinical Electrophysiology
TASER:	Thomas A. Swift Electric Rifle
VF:	Ventricular Fibrillation

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APPENDIX

1. British Home Office Defence Sciences Technology Laboratory Report

2. United States Department of Defense Human Effectiveness and Risk Characterization of Electromuscular Incapacitation Devices (HECOE Report)

3. Pacing and Clinical Electrophysiology (PACE Report)

4. University of Wisconsin and National Institute of Justice TASER Research Project

5. Effectiveness and Health Effects of Electro-muscular Incapacitating Devices (Dr. Jauchem)

6. United States of America Excessive and lethal force? Amnesty International's concerns about deaths and ill-treatment involving police use of TASERs

7. Canada Excessive and lethal force? Amnesty International's concerns about deaths and ill-treatment involving police use of TASERs

8. Information regarding Orange County Sheriff's Office (OSCO) Study

9. Madison Police Department TASER Report

10. Lethality of TASERs (James Angelo Ruggieri)

11. Patrick Reilly letter

12. Opinion on cardiac safety of the TASER weapon (Dr. Joel Kirsh)

13. Potomac Institute for Public Studies Report

14. Society of Academic Emergency Medicine Human Cardiac Safety of TASER Devices (Dr. Chan)